Mycobiology 34(4): 180-184 (2006)

Diversity of Keratinophilic Fungi on Human Hairs and Nails at Four Governorates in Upper Egypt

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(*Received September 1, 2006*)

The mycobiota of 160 hair and nail samples collected from 4 different governorates in upper Egypt were estimated using soil plate method for isolating keratinophilic and dermatophytic fungi. Twenty- three fungi were recorded on both hair and nail samples collected from the four governorates. Highest fungal diversity (20) was collected from Red Sea samples followed by Qena (18) and Aswan (17) while lowest fungal diversity was recorded from Sohage samples. The common genera were *Aphanoascus*, *Aspergillus*, *Penicillium*, *Paecilomyces* and *Chrysosporium*. The most prevalent species belonging to these genera were: *A. fulvescens*, *Aphanoascus* sp. *A. flavus* link, *A. flavus* var. *columnaris*, *P. chrysogenium*. *P. lilacinus* and *C. sulfureum*. True dermatophytes such as *Nannizzia fulva* appeared in 20~30% of the male samples.

KEYWORDS: *Aphanoascus*, *Chrysosporium*, dermatophytes

The keratinophilic fungi are of prime importance in regard to various skin diseases prevalent in various areas. These fungi are able to utilize keratin, a fibrous protein, as sole carbon and nitrogen source and survive saprophytically in nature (English, 1963). Many keratinophilic fungi frequently parasitize keratinous tissue, viz. skin, nails and hair in man and animals. Some of them share certain morphological features, constituting aspecial group called dermatophytes (Gugnani, 2000). The impact of keratinophilic fungi on human health seems unexplored part of various studies (Shukia *et al*., 2003). Dermatophytes and other keratinophilic fungi have been isolated from various keratinized part of body in animals and human (Abdel-Hafez, 1987; Nicholis and Midgley, 1989; Ali-Shtayeh *et al*., 2000; Alghalibi, 2001; El-Said, 2002; Dobrowolska *et al*., 2006).

Various keratinophilic fungi along with some dermatophytes are responsible for various skin infections, little epidemiological data on the fungal disease of skin in human is available (Shukia *et al*., 2003). Knowledge of the frequency and extension of etiological agents of humans and animal mycosis and other potentially pathogenic fungi on the healthy hairs and nails of humans is of prime importance for understanding of epidemiological cycle of these fungi (Otcenasek, 1978; Lee *et al*., 1990).

The present work is aimed at evaluating the biodiversity of keratinophilic fungi in Upper Egypt among male and female students of South Valley University at Aswan, Qena, Sohage and Red Sea Governorates.

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Materials and Methods

Sample collection. A total of 80 hair and 80 nail samples were collected from male and female students of South Valley University at Aswan, Qena, Sohage, and Red Sea Governorates. For the collection, 20 samples from each governorate and 10 samples sex were chosen at random. No samples taken from patients, all samples taken from students (aged 17~24 years). Hair and nail samples were placed, separately, in clean plastic bag and transferred to the laboratory and were stored at 4°C until fungal analysis.

Sample analysis. The soil plate technique (Bagy *et al*., 1997; Efuntoye and Fashanu, 2001) was employed to estimate the diversity of keratinophilic fungi. Each sample (10 hair fragments or nails) scattered separately on surface of about 40 gm sterile Petri-dishes and the dust moistened with sterilized water (25~30 moisture content) and remoistened when ever necessary. Two plates were used for each sample and the plates were incubated at room temperature 4~5 weeks. Ten hair fragments (5 fragments from each plates) or ten nails (5 nails from each plates) were transferred to the surface of Sabouraud's dextrose agar medium (SDA) (Moss and McQuown, 1969) supplemented with antibiotics e.g. chloramphenicol (0.5 mg/*ml*) and cycloheximide (0.5 mg/*ml*). Plates were incubated at 28 ± 2°C for 10~21 days and the culture were examined periodically for fungal growth. After incubation isolates were cultured on SDA for identification on the basis of their colonial and morphological characters

Table 1. Number of cases of isolation (NCI) of keratinophilic fungi isolated from nails and hairs of students of South Valley University at Aswan, Qena, Sohage and Red Sea Governorates

Genera and species	Aswan				Qena				Sohag				Red Sea				Total
	Nails		Hairs		Nails		Hairs		Nails		Hairs		Nails		Hairs		
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	
Dermatophytes and related fungi																	
Aphanoascus fulvescens (Cooke) Apinis	6	5	5	8	7	4	2	8	5	4	2	7	8	7	4	5	87
Aphanoascus terreus (Randhawa & Sandh) Apinis	0	0	5	0	0	0	5	0	0	0	4	0	0	0	3	0	17
Aphanoascus sp.	5	4	5	4	3	4	4	3	8	9	8	5	0	3	3	5	73
Artroderma curreyi Berk	0	0	0	0	0	0	1	0	0	0	0	0	3	0	3	0	7
Chrysosporium sulfureum (Fiedl.) Van Oorschot & Samson	0	0	0	0	0	0	0	0	4	2	0	0	2	0	0	0	8
Chrysosporium xerophilium Pitt	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	4
Myceliophthora vellerea (Sacc and Speg) van Ooschot	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Nannizzia fulva Stockdale	0	0	0	0	0	0	0	3	0	0	0	0	0	2	0	0	5
Other moulds																	
Alternaria alternata (Kris) Keissler	1	0	1	0	0	1	0	0	1	1	0	1	0	0	1	0	7
Aspergillus flavus link	4	5	3	2	7	4	1	2	2	0	4	5	5	1	1	6	52
Aspergillus flavus Var. *columinaris* Raper & Fennell	2	2	4	3	2	4	3	4	4	4	1	3	1	8	2	1	48
Aspergillus fumigatus Fresenius	0	2	0	0	0	1	0	0	2	1	0	0	1	0	0	0	7
Aspergillus niger Van Tieghem	4	4	1	1	4	2	0	0	2	1	0	0	1	3	2	0	25
Aspergillus parasiticus Speare	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
Aspergillus sullphureum (Fres.) Thom & Chruch	1	0	2	1	0	0	0	0	1	2	0	0	1	0	0	0	8
Aspergillus ustus (Bainier) Thom & Church	1	2	0	0	2	2	0	0	1	4	0	0	4	1	0	0	17
Candida albicans (Robin) Berkhout	1	1	0	0	0	2	0	0	2	2	0	0	0	0	0	0	8
Gibberella pulcaris (Fr. Ex Fr.) Sacc	1	3	0	0	0	1	0	0	0	0	0	0	4	1	0	0	10
Mucor hiemalis Wehmer	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	3
Pacilomyces lilacinus (Thom) Samson	0	0	0	1	0	0	5	0	1	2	8	0	0	0	2	0	19
Penicillium chrysogenium Thom	3	1	0	2	2	4	0	1	2	8	0	1	3	2	1	1	31
Penicillium funiclosum Thom	2	0	2	0	1	0	0	0	1	1	0	0	0	1	1	2	11
Penicillium griseofulvum Dierckx	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Total genera (12)	6	5	4	4	3	7	4	4	7	7	3	4	7	8	6	3	
Total species (22+1variety)	12+1v	11+1v	8+1v	7+1v	7+1v	12+1v	6+1v	5+1v	14+1v	12+1v	5+1v	5+1v	11+1v	12+1v	10+1v	5+1v	
Gross total fungi	15		10		14		9		15		8		17		11		
Gross total fungi in each Governorate	17				18				16				20				

F = female, M = male, v = variety

using monographic descriptions and other available literature (Stockdale, 1963; Van Oorschot, 1980; Spiewak, 1998; Kushwala, 2000).

Results

Keratinophilic fungi recovered from students' hairs Thirteen population were recorded on 80 hair samples collected from four governorates. The highest fungal (11) was collected from Red Sea samples followed by Aswan (10) and Qena (9) while lowest, (8) was recorded from Sohage samples.

Dermatophytes and dematophyte- like keratinophilic fungi were represented by 3 genera of which *Aphanoascus* was the most frequent genus being recovered from 90~100% of both male and female students' hairs samples. It was represented by 2 species and 1 unidentified species of which *A. fulvescences* and *Aphanoascus* sp. were most common, emerging in 50~80%, 40~50%; 20~80%, 30~40%; 20~70, 50~80% and 40~50% and 30~50%, from male and female students' hair from Aswan, Qena, Sohag and Red Sea governorates, respectively. *A. terreus* was isolated only from female students' hair, occurring in 30~50% of the samples. *Arthroderma curreyi* also isolated only from female students' hair recovered from 10~30% of the samples from Qena and Red Sea Governorates. *Nannizzia fulva* recovered only from Qena male students' hair, emerging in 30% of the samples.

Other keratinophilic fungal species (4 genera) were also isolated, of which *Aspergillus* was isolated in high frequency of occurrence. It was isolated from 60~80% and 40~80% of the male and female samples, respectively. It was represented by 3 species and 1 variety, of which *A. flavus* and *A. flavus* var. *columinaris* were the most common. *Paecilomyces* was recovered in high frequency of occurrence from female samples, contributing in 20~80% of the total samples, but in low frequency (0~10%) from male students' hairs. *Penicillium* was isolated in low frequency of occurrence recovered from 10~30% and 0~20% of the samples, respectively. It was represented by 2 species, it were *P. chrysogenium* and *P. funiculosum*. *Alternaria alternata* was also isolated in low frequency of occurrence, occurring in 0~10% of both male and female samples.

Keratinophilic fungi recovered from students' nails. Twenty-one species and one variety belonging to 12 genera were recovered from male and female students' nails from Aswan, Qena, Sohage and Red Sea governorates.

Dermatophytes and closely related fungi were represented by 5 genera of which *Aphanoascus* was the most frequent genus and was recovered from 80~90% and 80~100% of both male and female students' nails from these governorates. It was represented by *A. fulvescens* and *Aphanoascus* sp. They were the most frequent species, they encountered in 50~60%, 50~40%; 40~70%, 30~40%, 40~50%, 80~90% and 70~80% and 30~0%, from male and female samples from the four Governorates. *Chysosporium* ranked second in frequency of occurrence which represented by 2 species of which *C. sulfureum* was isolated only from Sohage and Red Sea governorates. emerging in 20%, 0% and 40%, 20% of male and female nails samples. *C. xerophilium* was isolated only from Red sea male students' nails, contributing in 40% of the studied samples. *Arthroderma curreyi*, *Myceliophthora vellerea* and *Nannizzia fulva* were isolated only from Red sea samples of which *Arthroderma*, emerging 30% from female students' nails only. *Myceliophthora* and *Nannizzia* were recovered only from male samples encountered in 10% and 20%, respectively.

Other keratinophilic fungi were represented by 7 genera of which *Aspergillus* was isolated in high frequency of occurrence, emerging in 80~100% of both male and female students' nails from these governorates. It was represented by 6 species and 1 variety of which *A. flavus* and *A. flavus* var. *columinaris* were the most common. *Penicillium* ranked secondly among the most common from the other keratinophilic fungi genera. It was recovered from 10~80% and 20~30% of the samples. It was represented by 3 species of which *P. chrysogenium* was the most frequent. *Gibberella* represented by (*G. pulcaris*) ranked third after *Penicillium*. It was isolated from 10~30% and 10~40% of male and female samples, respectively. The remaining genera were recovered, but with low frequencies of occurrence from male and female students' nails and these were; *Candida* (*C. albicans*), *Mucor* (*M. hiemalis*) and *Paecilomyces* (*P.lilacinus*).

Discussion

Fungi associated with students' hairs. Thirteen fungi were collected from male and female students' hairs. *Aphanoascus* was the most common genus from male and female students' hairs. It was represented by *A. fulvescens* (anamorph: *Chrysosporium keratinophilium*), *A. terreus* (anamorph: *C. indicum*) and *Aphanoascus* sp. (anamorph: *C. tropicum*). *Aphanoascus* spp. were recorded from human hairs in Assiut, Egypt (Moharam *et al*., 1988) and human hairs at Qena and Red Sea governorates (Maghraby, 1994) and from hair and scalp of school children in Palestine (Ali- Shtayeh, 2000).

Arthroderma curreyi (anamorph: *Chrysosporium* anamorph of *Artroderma curreyi*) emerged in 10~30% only from female students' hairs at Qena and Red Sea. This species has of world-wide distribution (El-Said, 1995; Ulfig *et al*., 1996: Hubalek, 2000).

Nannizzia fulva (anamorph: *Microsporium gypseum*) ecountered in 30% only from Qena male students' hairs.

Maghraby (1994) found *M. gypseum* (9.1%) from students' tinea capitis samples at Qena and Red Sea Governorates.

Member of *Aspegillus* (3 species + 1 variety), *Paecilomyces* (1), *Penicillium* (2) and *Aternaria* (1) were recovered from hairs of both sexs. These fungi were isolated previously from hairs of large mammals or feathers of poultry and human (Aho, 1983; Abdel-Hafez, 1987, 1990; Ali-Shtayeh, 2000; Alghalibi, 2001).

Fungi associated with students' nails. Twenty-one fungi belonging to 12 genera were recovered from male and female students' nails. Dermatophytes and related fungi were represented by 5 genera of which *Aphanoascus* was the most frequent genus. *A. flvescens* and *Aphanoascus* sp. were infrequently encountered from male and female nails. Previously, these species were isolated with different incidences, from students' nails (Abdel-Hafez and El-Sharouny, 1990; Abdel-Raouf, 2000), chicken and pigeon claws (Abdel-Hafez, 1989). *Chrysosporium* ranked second in frequency, it was represented *C. sulfureum* and *C. xerophilium* which was isolated previously from students' nails at Sohage Region (Abdel0Raouf, 2000).

Artroderma curreyi (*Chrysosporium*: anamorph *Arthroderma curreyi*), *Myceliophthora verllera*, and *Nannizzia fulva* (anamorph: *Microsporium gypseum*) were encountered through our study, those species were previously isolated by Katiyar and Kushwaha (2000) and Efuntoye and Fashanu (2001).

Several saprobic and cycloheximide resistant fungi such as *Alternaria*, *Aspergillus*, *Candida*, *Gibberella*, *Mucor*, *Paecilomyces* and *Penicillium* were recovered from students' nails. These species were isolated previously, but with different frequency, from students' nails (Abdel-Hafez and El-Sharouny 1990), cloven-hooves and horns of goats and sheep (Abdel-Hafez *et al*., 1990) and from domestic birds nails (Efountoye and Fashanu, 2001).

In conclusion, highest fungal diversity (20 species) was recorded from Red sea samples followed by Qena (18) and Aswan (17) while the lowest fungal diversity (16) was recorded from Sohage samples. Red sea governorates is coastal city with high humidity level while Qena and Aswan have higher temperature range than Sohage governorate. It is well known that high temperature and humidity are favored for fungal growth. High number of fungal species was recorded from nail samples compare to those recorded from hair samples at the four governorates and this is in agreement with the previous studies. (Moharam *et al*., 1988; Maghraby, 1994; El-Said *et al*., 1995; Abdel-Raouf, 2000; Ali-Shtayeh, 2000).

References

Abdel-Hafez, A. I. I. 1987. Survey on the mycoflora of goat and sheep hairs from Gaza strip. *Bull. Fac. Sci. Assiut Univ.* **16**: 15-21.

Abdel-Hafez, A. I. I. 1989. Keratinophilic fungi of chicken and pigeon claws from poultry feathers in Egypt. *Qatar Univ. Sci. Bull.* **11**: 135- 154.

Abdel-Hafez, A. I. I. 1990. The prevalence of keratinophilic and saprobic fungi on poultry feathers in Egypt. *Qatar Univ.Sci. Bull.* **11:** 135- 154.

Abdel-Hafez, A. I. I. 1989 Keratinophilic fungi of chicken and pigeon claws from Egypt. *Cryptogamie-Mycologie* **10**: 165-171.

Adel-Hafez, A. I. I. and El-Sharouny, H. M. 1990. Keratinophilic and saprophytic fungi isolated from student's nails in Egypt. *J. Basic Microbiol.* **30**: 3-11.

Adel-Hafez, A. I. I, Moharram, A. M. and Abdel-Gawad, K. M. 1990. Survey of keratinophilic and saprobic fungi in the cloven-hooves and horns of goats and sheep from Egypt. *J. Basic Micobiol.* **30**(1): 13-20.

Abdel-Raouf, N. M. 2000. Studies on keratinophilic fungi of school in Sohage Region. *M.Sc., Thesis. South Valley Univ., Qena, Egypt.*

Aho, R. 1983. Saprophytic fungi isolated from hair of domestic and laboratory animals with suspected dermatophytoses. *Mycopathologia* **83**: 65-73.

Alghalalibi, S. M .S. 2001. Keratinophilic fungi and other moulds recovered from sheep wool in yemen. *Bull. Fac. Sci. Assiut Univ.* **30**: 147-155.

Ali-Shtayeh,, M. S., Salameh, A. A. M., Abu-Ghdeeib, S. I. and Jamous, R. M. 2000. Hair and scalp mycobiota in school children in Nablus area *Mycopathologia* **150**: 127-135.

Bagy, M. M. K., Abdel-Mallek, A. Y., El-Shanawany, A. A. and Gamal, A. M. 1997. Studies on fungi associated with laboratory animal golden hamaster and antibiotic effects of aloe sap, garlic extract and onion oil. *J. Islam. Acad. Sci.* **10**: 1-9.

Dobrowolska, A., Staczek, P., Kaszuba, A. and Kozlowska, M. 2006. PCR-RFLP analysis of the dermatophytes isolated from patient in central Poland. *Journal of Dermatological Science* **42**: 71-74.

Efuntoye, M. O. and Fashanu, S. O. 2001. Occurrence of keratinophilic fungi and related dermatophytes on domestic birds in Nigeria. *Mycopathologia* **153**: 87-89.

El-Said, A. H. M. 1995. Keratinophilic fungi in soils of Yemen Arab Republic *J. Islam. Acad. Sci.* **8**: 151-154.

El-Said, A. H. M. 2002. Studies on fungi isolated from dermatomycoses patients in Egypt. *Mycobiology* **30**: 154-159.

El-Said, A. H. M. and Abdel-Hafez, S. I. I. 1995. Keratinophilic fungi associated with human hair in Yemen. *Cryptogamie Mycolgie.* **16**: 129-133.

English, M. P. 1963. The saprophytic growth of keratinophilic fungi on keratin. *Sabouraudia* **2**: 115-130.

Gugnani. C. H. 2000. Nondermatophytic filamentous keratinophilic fungi and their role in human infection, in: Biology of dermatophytes and other keratinophilic fungi. *Revista Iberoamericana de Micologia, Bilbao*. Pp 109-114.

Hubalek, Z. 2000. Keratinophilic fungi associated with free-mammals and birds, in: Biology of dermatophytes and othe keratinophilic fungi. *Revista Iberoamericana de Micologia, Bilbao*. Pp 93-103.

Katiyar, S. and Kushwaha, R. K. S. 2000. Human hair colonizing fungi in water sediments of India. *Mycopathologia* **152:** 81-84.

Kushwala, R. K. S. 2000. The genus *Chrysosporium*, its physiol-

ogy and biotechnological potential, in: Biology of dermatophytes and other keratinophilic fungi. *Revista Iberoamericana de Micologia, Bilbao*. Pp 66-76.

Lee, M. M., Diven, D. G., Smith, E. B. and Pupo, E. B. 1990. Onychomycosis. *Archives of Dermatology* **126**: 402.

Maghraby, T. A. 1994. Studies on the mycoflora of schools at Qena and Red sea Governorates. *Ph.D., Thesis. Assiut Univ., Egypt.*

Moharram, A. M., Abdel-Gawad, K. M. and Mohamed El-Magraghy, S. S. 1988. Ecological and physiological studies on fungi associated with human hair. *Folia Microbiol.* **33**: 363-371.

Moss, E. S. and McQuown1, A. L. 1969. Atlas of medical mycology. 3rd edition. The Williams and Wikins Company. Baltimore. P 366.

Nicholis, D. S. H. and Midgley, G. 1989. Onychomycosis caused by *Trichophyton equinum*. *Clinical and Expermental Dermatology* **14**: 464-465.

Otcenasek, M. 1978. Ecology of dermatophytes. *Mycopathologia* **65**: 67-72.

Shukia, P., Skukla, C. B., Kango, N. and Shukla, A. 2003. Isolation and characterization of a dermatophyte, *Microsporium gypseum* from poultry farm soils of Rewa (Madhya Pradesh), India. *Pakis. J. Bio. Sci.* **6**: 622-625.

Spiewk, R. 1998. Zoophilic and geophilic fungi as cause of skin diseases in farmer. *Ann. Agric. Environ. Med.* **5**: 97-102.

Stockdale, P. M. 1963. The *Microsporium gypseum* complex. *Sabouraudia* **3**: 114-126.

Ulfig, K. Terakowski, M. Plaza, G. and Kosarewicz, O. 1996. Keratinophilic fungi in sewage sludge. *Mycopathologia* **136**: 41-46.

Van Oorskchot, C. A. N. 1980. Revision of *chrysosporium* and allied genera. *Studies in Mycology* **20**: 1-87.